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ABSTRACT

This monograph includes guidelines for science courses in grades seven, eight, and nine, and for biology, chemistry and physics. Seventh grade Environmental Life Science is lab-oriented and based on a variety of student experiences. Course objectives are presented as well as the course outline. A multitext approach, with a suggested textbook list, is organized on reading ability level. The Earth Science Course, grade eight, focuses the attention of the student on the physical world in which he lives. Instructional materials suggested include films, filmstrips, and reference books and publications. The ninth grade curriculum exposes students to many physical science areas as well as a basic background for physics and chemistry students. A Materials List suggests texts and experiments that could be incorporated into the program. The major objectives of Biology I, the course content and supplementary materials are built around the BSCS green and yellow versions, an ecological approach. Supplementary materials include lab exercises, field exercises and films. Included in the chemistry curriculum are plans for an academic chemistry section and a terminal science section. Cotton and Lynch's "CHEMISTRY: An Investigative Approach" is used for academic students and Metcalfe, Williams, and Castka's MODERN CHEMISTRY, for the non-academic course. The textbook "Modern Physics" by Del, Metcalfe and Williams is used in the physics course. (EB)

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INDIAN RIVER SCHOOL DISTRICT
SCIENCE CURRICULUM GUIDELINES

By

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June 30, 1973

Printed and disseminated through the office of the Del Mod Component Coordinator for the State Department of Public Instruction, John G. Townsend Building, Dover, Delaware 19901

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INDIAN RIVER SCHOOL DISTRICT

Science Curriculum Guidelines

I - Seventh Grade

II - Eighth Grade

III - Ninth Grade

IV - Biology

V - Chemistry

VI - Physics

These guidelines were developed and written by participants in a workshop funded by Del Mod during the 1972 - 73 school year.

7th Grade Environmental Life Science

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Submitted by Science Committee

Robert M. Johnson - Chairman

Dennis E. Banks

Edward W. Radle

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I. Introduction

A. Course Reasoning

Seventh grade Environmental Life Science is a course designed to give the student a better understanding of his responsibilities within the world of living things; to develop in the student an interest in science through participation in basic experiments; to form a connecting link between his elementary introduction to science and his future studies in the field of science; to introduce the use of scientific procedure as a method of problem solving, but above all to teach the student to think.

The course is lab-oriented and is based on the concept that a child learns best when he is involved in a variety of experiences in which he finds enjoyment and personal satisfaction.

The concept of teaching to the student level is recommended, therefore subject content and the weight of factors used in evaluating must be flexible and adapted to the level of instruction. It is believed that the teacher should expect much from the individual student in the hope that the student will be motivated to work to his fullest capacity.

B. The Processes of Science involved in the development of the unit subject content.

1. The basic processes.

   a. observing
   b. inferring
   c. using numbers
   d. using space-time
   e. measuring
   f. communicating
   g. classifying
   h. prediction

2. The special processes

   a. formulating hypothesis
   b. defining operationally
   c. controlling variables
   d. formulating models
   e. interpreting data
   f. experimenting

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II. Objectives

A. to relate the concepts of science to the lives and problems of the students

B. to interweave through the curriculum the thread of environmental ecology through the concept of interdependence among all living things and between living things and their environment.

C. to encourage the student to think.

D. to instill the concept that there is joy and purpose in learning.

III. Unit Subject Content - Flexible
Suggested a four 9-week units.

A. Microscopic Organisms

1. The Microscope

simple - compound - dissecting

2. Life within a drop of water.

Algae - protozoans - arthropods - rotifers
Algae - blue-green algae, euglenoids, green algae, diatoms
Protozoans - flagellates, pseudopod animals, ciliats and spore formers
Arthropods - copepods, shrimps, etc.
Rotifers

3. Bacteria - Yeast - Molds

positive and negative economic value

4. Cell Structure

Organells and their function, basic cell structure, comparison plant and animal cells

5. Laboratory tools used in quantitative observations.

meter stick - graduated cylinder - grain balance

6. The senses as used in qualitative observations.

sight - touch - sound - taste - smell

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B. Man in His Environment

1. Genetics

DNA molecule - inherited characteristics - dominant and recessive traits - acquired characteristics - environmental factors - limitations

2. The Brain

nerve cells and tissue - cerebrum - cerebellum - medulla - human superiority

3. The Races of Man

Caucasians - Negroes - Mongolians

likenesses and differences

4. Body Structure

circulatory system - digestive system - respiratory system - muscular system - excretory system - skeletal system - reproductive system

5. Environmental Pollution

problems, preventive measures, remedial measures, long-range planning

C. The Building Blocks of Man's World - Basic Chemistry

matter - elements - compounds - energy exchange - classification - indicators - special procedures - symbols - formula - basic equations - the atomic model

D. The Green Seed Plant

1. Energy Exchange through Photosynthesis

energy source - conversion - potential energy - carbohydrates - proteins - fats - oils - vitamins

2. Structure and Function

roots - stems - leaves - flowers - seeds

3. Reproduction - the reproductive cycle

pollination - fertilization - male and female reproductive structures - seed production - mitosis: the stages of cell division

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4. Cycles affecting Plant Production

   water cycle - nitrogen cycle - carbon dioxide - oxygen cycle

5. Drugs from Plants

   home remedies - pharmaceuticals - alcohol - tobacco - drug addiction - marijuana - narcotics - commercial drugs of non-plant origin.

6. Classification - traditional

   non-vascular plants: bacteria - algae - mosses

   vascular plants: ferns - seed plants

E. The Animals of Man's Environment

1. Common Invertebrates

   protozoans - sponges - jellyfish - flatworms - roundworms - starfish - segmented worms - mollusks - arthropods

   Movement - growth - reproduction - reactions to environmental conditions - body structure - structural adaptations for survival - economic importance - interdependence as exhibited through food chains and webs - energy exchange - classification

2. Common Vertebrates

   fishes - amphibians - reptiles - birds - mammals

   Movement, etc.

3. Survival vs. Economic Growth

   wetlands - breeding areas - nesting areas - energy webs - vs. progress through building and commercial development.

IV. Suggested Textbook List
(current additions) - multitext approach

A. Below Average to Average Level

1. Pathways in Science
   Biology 1, 2, 3
   Globe Book Co., Inc.

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B. Average to Above Average

1. Pathways in Science
   Biology 1, 2, 3
   Globe Book Co., Inc.

2. The World of Living Things
   Harcourt, Brace & World, Inc.

3. Life, Its Forms and Changes
   Harcourt, Brace & World, Inc.

4. Life Science - A Problem Solving Approach
   Ginn

5. Interactions of Man and the Biosphere
   Rand McNally

6. Man and the Environment
   Houghton Mifflin

7. The Biological Sciences
   Laidlaw

V. Committee Recommendations

1. that the suggested units of the curriculum be adapted to the specific needs of the school in which it is taught.

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Eighth Grade Science Outline

Submitted by Science Committee

Robert M. Johnson - Chairman

Dennis E. Banks

Edward W. Radle

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Eighth Grade Suggested Course Outline

Indian River School District

I. Applied Horticulture

- a. Soil formation and soil profiles
- b. Micro and Macro nutrients and plant feeding
- c. Scientific measurements and experimental design
- d. Natural cycles and composting
    1. Plant feeding experiment
- e. Propagations
    1. Asexual: Cuttage
    2. Sexual: Formation of seeds
- f. Growing vegetable transplants for the home garden
- g. The use of Mulches in the home garden
- h. Control of insects
    1. Equipment involved in insect control
    2. Chemical methods of insect control
    3. Problems with chemical insect control and some alternatives
- i. Planning a garden

II. Rocks, Minerals and Land Forms

- a. Constructional forces
- b. Land forms: mountains, plateaus, plains and lakes
- c. Physiographic areas of the U.S.
- d. Destructive forces
    1. Weathering
    2. Mass Wasting
    3. Wind and water
    4. Surface water and glaciers
- e. Topographic maps and land forms
- f. Specific rocks and minerals

III. Marine Science

- a. Currents in the ocean
- b. History of oceanography
- c. Topography of the marine environment
- d. Pelagic and Benthic organisms
- e. The composition of sea water

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IV. Meterology

a. The atmosphere
b. Temperature
c. Humidity
d. Air Pressure
e. Air masses

Astronomy

a. The Solar System
b. Tools of the astronomer
c. Space exploration

V. Pollution

a. Human pollution - drugs

1. Narcotics
2. Depressants, Stimulants, and Psychedelics
3. Alcohol and tobacco

b. Noise, water, and air pollution
c. The Ecosystem - lakes, vacant lots, a school yard, a lawn
d. Food chains
e. Solutions to environmental problems - What you can do

The Metric System is used throughout the Earth Science Course. Students are given many opportunities to become familiar with this system of measurement, and to become reasonably proficient in the measurement of length, weight, volume, and temperature.

Course Content and Student Level of Achievement

Teachers presently teaching Earth Science feel in general that homogeneous grouping on the basis of the students average achievement still left a rather heterogeneous group as far as ability is concerned. Further, the individual as well as the class receptivity, especially in the "lower sections" ebbs and flows. Consequently, it is not possible to suggest here a program specifically tailored to a given group of students. The progress each section receives, within the framework of the program outlined, is pretty much a "seat of the pants" affair, with frequent adjustments being made to respond to the students' interests, aptitudes, etc.

Textbooks and Resource Materials

The diverse subject areas covered in the Earth Science program naturally leads to a broad range of instructional material. The following list is not meant to be inclusive, but

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rather indicative of the instructional materials to which the student is exposed:

1. Delaware State Film Library - numerous films on all areas of Earth Science

2. Modern Talking Pictures, Inc. - Science Films

3. Filmstrips

   a. Understanding Oceanography by Singer
   b. Soil, It's Meaning For Man by Schloat Productions
   c. Our Living Soil by National Plant Food Institute
   d. Life of the Green Plant by National Plant Food Institute

4. The Encyclopedia of Organic Gardening - Rodale Press

5. Earth Science - The World We Live In by Namowitz and Stone, American Book Co.

6. Exploring Earth Science by Thurber and Kilburn, Allyn & Bacon, Inc.

7. Numerous U. S. Department of Agriculture and State of Delaware Publications on Gardening

Objectives

The objectives of the Earth Science Course in the Indian River School District are:

1. To focus the attention of the student on the physical world in which he lives.

2. To help the student to understand some of the processes involved in the formation of his environment and the forces that cause sometimes rapid and sometimes gradual changes.

3. To continue to develop environmental awareness in the students.

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Ninth Grade Physical Science

Compiled By

Thomas H. Milspaw

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The overall ninth grade objective is to expose science students to as many physical science areas as possible while giving a basic background for higher physics and chemistry students.

The proposed curriculum is divided into three major topics. These could be used as twelve (12) week mini-courses or taught together by one teacher. The nature of the schedule and teacher compliment will determine the best method of curriculum presentation.

The system employed by one school uses three (3) teachers each teaching the same unit for three (3) twelve (12) week periods. The students rotate teachers and receive a thirty-six (36) week total block in three (3) twelve (12) week mini-courses.

Advantages of this system are the teacher has less areas to prepare for, less materials necessary to teach the unit, no changing of supplies from room to room, less teacher-student boredom and in one year the teacher improves his teaching as if the subject was taught three (3) years. Some disadvantages are also present. The students have to learn to adjust to new teachers, grades must be passed along in the middle of two of the four marking periods requiring more paper work, and long term projects are prohibited past the twelve week unit.

The passing of grades in the middle of a marking period could be eliminated by teaching four nine-week units. The outline provided can be rearranged to provide for a fourth unit of instruction. The proposed fourth unit can be taken from the chemistry and energy section by creating a unit on raw materials consumption, process, utilization and including the idea of the energy crisis.

The following basic outlines can be used with all levels of ninth grade. The material presented must fit the student's abilities. If all labs are written by the teacher, the reading level of the students involved can be matched better than just taking something from a text. This also helps use materials available and allows the teacher to be more familiar with the investigation. The key is to be flexible. The investigations need not be complicated. The idea is to get the major ideas across.

<u>Energy Unit</u>

I. Heat

- A. Temperature, Calorie
- B. Thermometers and temperature conversion equations
- C. Color absorption of heat
- D. Lenses
  1. Concentration of heat and light
- E. Heat of vaporization and fusion

II. Light

A. Refraction and reflection
B. Mirrors and lenses effect on light
C. Prism-spectrum
D. Color
E. Eye parts and function

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III. Sound

A. Vibrations - wave form
B. Reflection
C. V=FL
D. Ear parts and function
E. Music, tuning fork and various instruments
F. Resonance

IV. Electricity and Magnetism

A. Basic principles, magnetic fields and compass
B. Batteries, generators and electric motors
C. Electronic circuits and components
D. Power plants to homes system
E. Communication - telephone, telegraph and satellite

V. Nuclear

A. Reaction principles, decay and half life
B. Atomic reactors
C. Destructive weapons

VI. Raw Materials - Utilization, Processing and Consumption

A. Coal	)	How obtained - drilling and mining
B. Oil	)	Separation - purification
C. Natural gas	)	Uses of each
D. Iron	)	Steel production
E. Aluminum	)	Alloy properties
F. Copper	)	Refractional distillation
	)	Wire production

Chemistry Unit

I. Chemistry of Matter

A. Branches of chemistry
B. Matter, element, compounds and mixtures

II. Matter and Energy

A. Molecular theory
B. States and properties of matter
C. Physical and chemical changes
D. Conservation laws of matter and energy

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III. Atoms

A. Structure, components and weight

IV. Chemical Activity

A. Activity series
B. Compounds and ions
C. Equations

V. Periodic Table

A. Arrangement into periods and groups
B. Isotopes and radioisotopes

VI. Water

A. Properties, solutions, suspensions and colloids
B. Purification and pollution

VII. Acids, bases and salts

A. Properties of each
B. Neutralization
C. Other reactions

VIII. Iron and Steel, Organic Chemistry (as time permits)

Materials List

Interaction of Matter and Energy, Rand McNally, 1969

Cambridge Work-A-Text, Physical Science, Cambridge Book Co., Inc. 1970

Physical Science, Ginn, 1971.
A problem-solving approach

Science Prob. 3, Scott, Foresman & Co., 1958

700 Science Experiments for Everyone, compiled by UNESCO, Doubleday Co., 1958

The textbook list is not used by all teachers and no one text is sufficient reference. Investigations, reading material, terms can be taken from any combination. Each teacher must be creative in using the materials to the fullest extent. This may and usually does require many of the labs being written by the instructor to accomodate the materials and student ability. The list of texts provided can be a source material for ideas to make the best use of materials available.

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Biology

Compiled By

Larry Conroy

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Introduction

In developing a course of study for biology students, it should be understood that varying content and techniques should be used according to the needs and desires of the student.

The programs used within the district are the B.S.C.S. green and yellow versions. Both of the aforementioned programs are laboratory and inquiry oriented, using lecture only when essential. The content of the two programs is basically the same although they are approached from different viewpoints.

At Indian River the Biology I program in which the B.S.C.S. green version is used, is intended to give information and knowledge lending to an informed citizenry. The basis of the program is a treatment of ecological relationships and problems Those students desiring greater depth in the field of Biology may elect to take the Biology II course.

The course at Sussex Central is slanted toward introducing the student to the many aspects of Biology and includes a greater emphasis on the cell and the chemistry of the cell. There is no Biology II course at Sussex Central Senior High School.

The courses of study have been briefly outlined, and because of the absence of Biology II at S.C.S.H.S. and differences in the type student makes it impractical to have a duplicate course of study in the two schools.

Major Objectives of Biology I

A. To have students realize that living things change and have changed throughout time.

B. The student should understand that there is a diversity of type, but also a unity of pattern in living things.

C. To create a knowledge of the genetic continuity of life.

D. The student should see the relationship and dependence of all organisms upon others.

E. To see the complementarity of structure and function.

F. To realize the preservation of life in the face of change.

G. To understand and discover science as an inquiry.

H. To understand the history of biological concepts.

I. To produce skills in scientific work.

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Course Content (Green Version I.R.H.S.)

I. The World of Life

A. The Web of Life

1. The student will gain an understanding of energy relationships between animals and plants.

2. The student will realize the part that man plays in the living world.

B. Individuals and Populations

1. The student should understand the natural law involved with population dynamics.

2. The student should know what a population is and what causes it to change.

C. Communities and Ecosystems

1. The student will understand what a biotic community is and the various kinds of community interactions.

II. Diversity Among Living Things

A. The student will see some of the forms animal life can take.

B. The student will see some of the forms plant life takes.

C. The student will see some of the forms that organisms in the Protist Kingdom may have.

D. The student should understand that there are structural patterns in all three kingdoms.

III. Patterns in the Biosphere

A. Patterns of Life in the Microscopic World

1. The student will understand the relationship between bacteria and diseases.

2. The student will identify the many roles the micro-organisms play in the soil.

B. Patterns of Life on Land

1. The students will work experiments to demonstrate the idea of tolerance.

2. The student will be able to show the relationship between tolerances and the distribution of organisms.

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C. Patterns of Life in the Water

1. The student should become familiar with the various abiotic factors of bodies of water.

2. The student should describe the chemical characteristics of sea water and how it affects marine life.

IV. Within the Individual Organism

A. The Cell

1. The students will identify the various parts of cells.

2. The students will describe the mitotic division of cells.

B. Heredity

C. The Functioning Plant

D. The Functioning Animal

Materials

BSCS Green Version, BSCS Yellow Version Sec. Ed. 1968

Supplementary Materials

1. Lab Exercises
2. Field Exercises
3. Films

a. "The World of Life" A:BS Secondary Film Series
b. "The Community"
c. "Life in the Oceans"
d. "Bacteria"
e. "The Desert"
f. "The Pond"
g. "How Did Life Begin"
h. "Evolution of Man"
i. "Social Insects"
h. "DNA"
k. "The How of Life"
l. "World of Microbes"
m. "The Temperate Deciduous Forest"
n. "The Tropical Rain Forest"
o. "The High Arctic Rain Forest"

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Course Content of the Yellow Version

I. Unity

A. Biology - What is it about

B. Life from Life

C. Basic Structure

D. Basic Functions

E. Living Chemistry

F. The Physiology of Cells

G. The Reproduction of Cells

H. The Balance of Nature

II. Diversity

A. Viruses

B. Bacteria

C. Small Organisms of Great Importance

D. Molds, Yeasts and Mushrooms

E. The Land Turns Green

F. Photosynthesis - The Link Between Two Worlds

G. Stems and Roots - A Study of Complementarity of Structure and Function

H. Reproduction and Development in Flowering Plants

III. Animals

A. Digestion in Multicellular Animals

B. Transportation Within Multicellular Animals

C. Respiration in Multicellular Animals

D. Excretion in Multicellular Animals

E. Coordination in Multicellular Animals

F. Animal Support and Locomation

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OUTLINE FOR CHEMISTRY

Compiled By
Catherine Bither

Included in this set of outlines are plans for an academic chemistry section and a terminal science section. For the academic students, the book, "Chemistry: An Investigative Approach" can be followed fairly closely. Some modification is needed in areas the teacher feels are not necessary in high school chemistry. Some of the chapters do not have labs included. Labs dealing with these areas and other related areas can be included from other sources such as "Exercises and Experiments in Chemistry" by Metcalfe, Williams and Castka, published by Holt, Rinehart and Winston, Inc.

The terminal science students' course in the modified chemistry course mentioned in the teacher's guide to Modern Chemistry by Metcalfe, Williams, and Castka, published by Holt, Rinehart and Winston, Inc.

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For Academic Chemistry Students

Book - CHEMISTRY: AN INVESTIGATIVE APPROACH, Cotton and Lynch, 1970, Houghton, Mifflin

1. Introduction to the Course

   A. Experiments demonstrating scientific method
   B. Introduction to scientific method

2. Measurement - Review of Past Knowledge

   A. Metric System
   B. Scientific notation, uncertainty, significant figures

3. Atoms and molecules in gases

   A. Pressure
   B. Volume
   C. Temperature
   D. Relation between the three
      (NOTE: the text does not deal with gas laws in great detail. The text, Chemistry Problems, by Joseph Castka, deals with these in chapter 7.)
   E. Mole concept
   F. Introduction to molecular formulas
   G. Partial pressures

4. Elements and Compounds

   A. States of matter
   B. Elements, symbols, and names
   C. Chemical equations

5. The Atom

   A. Nature of particles in the atom
   B. Charge characteristics
   C. Decomposition of atoms

6. Periodic Table - review

   A. Regularities
   B. Noble gases-stability
   C. Alkali metals
   D. Halogens
   E. Periods of the table

7. Proof of Atoms

   A. Using chemical evidence to prove theory

      1. Law of simple multiple proportions
      2. Law of combining volumes
      3. Electrical nature evidence

   B. "Seeing" atoms - evidence of existence

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8. Orbital and Electronic Structure

   A. Introduction to nature of light
   B. Energy levels
   C. Quantum mechanics
   D. Ionization energy

9. Chemical Bonding

   A. Forces of bonds
   B. A look at some individual elements
   C. Shape of molecules
   D. Types of bonds

10. Solids, Liquids, Solutions

   A. Properties of each
   B. Forces between atoms
   C. Forces in compounds
   D. Ionic solids
   E. Solutions in depth
   F. Hydrogen bond

11. Chemical Reactions and Calculations

   A. Chemical formulas - how to write them
   B. Chemical equations

12. Energy Effects in Chemical Reactions

   A. Heat absorbtion and release
   B. Conservation of energy
   C. Energy stored in matter

13. Chemical Reaction Rates

   A. Factors determining reaction rates

14. Chemical Equilibrium

   A. Qualitative aspects
   B. Quantitative aspects

15. Equilibrium in solutions

   A. Introduction
   B. Types of solutions

16. Acids and Bases

   A. Electrolytes
   B. General properties
   C. Strength of acids

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17. Oxidation and Reduction

    A. Introduction
    B. Prediction of Reactions
    C. Balancing equations

Through various experiments not included in the chapters, other areas can be introduced and those in the book can be reinforced.

Non-academic Chemistry Students

Book - MODERN CHEMISTRY, H. Clark Metcalfe, John E. Williams, and Joseph F. Castka, 1968, Holt Rinehart and Winston

1. Introduction to Chemistry

    A. Matter and energy
    B. Metric System
    C. Measurement - uncertainty

2. Matter

    A. Classes of matter
    B. Symbols, compounds and mixtures
    C. Changes in matter

3. Atomic Structure

    A. Atomic theory
    B. Structure of the atom
    C. Atomic mass, Avogadro's number, atomic weight

4. Electronic Configuration

    A. Energy levels
    B. Electron configuration

5. Periodic Law

    A. Classification of elements
    B. Periodic table
    C. Periodic properties

6. Chemical Bonds

    A. Ionic bonding
    B. Oxidation number
    C. Covalent bonding
    D. Electronegativity

7. Chemical Composition

    A. Formulas and nomenclature
    B. Mole and mass quantities

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8. Chemical Equations

   A. Writing equations
   B. Mass-mass problems

9. Gas Laws

   A. Boyle's Law
   B. Charles' Law
   C. General gas law
   D. Density of gases
   E. Specific gravity
   F. Molar volumes of gases
   G. Volume gas - volume gas problems
   H. Mass-gas volume problems

10. Liquids, Solids, and Water

   A. Physical properties of liquids
   B. Gas-liquid phase changes
   C. Physical properties of solids
   D. Liquid-solid phase changes

11. Solution Process

   A. Kinds of solutions
   B. Temperature and pressure effects
   C. Heat of solution, boiling and freezing points
   D. Selecting solvents
   E. Colloidal state

12. Halogens

   A. Study properties of halogens
   B. Experiments concerning these elements

13. Nitrogen

   A. Properties, uses
   B. Ammonia, uses
   C. Nitric acid

14. Carbon

   A. Compounds, elemental forms
   B. Hydrocarbons
   C. Substitution products of hydrocarbons
   D. Natural organic compounds

15. Aluminum and Metalloids

16. Acids, Bases, and Salts

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PHYSICS PROGRAM - 1972 - 73

Dale Macon
Charles Reaves

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Physics Program

Textbook - MODERN PHYSICS, Dull, Metcalfe, & Williams, 1954 Holt, Rinehart & Winston; NEW MODERN PHYSICS, 1972 (on order) and Lab Manual

1st Week

1. The student shall demonstrate an understanding of the basic conservation laws (energy, momentum and charge).

2. The student shall be able to measure bodies in the metric system (ruler) to within an accuracy of $\pm$ .1 cm.

3. The student shall demonstrate an understanding of experimental deviation, experimental error, standard deviation and mean deviation by calculating each for all measurements.

2nd Week

1. The student shall work 8 out of 10 problems involving right triangles, trig. functions and the sine and cosine laws.

2. The student shall make 5 measurements using a vernier caliper. The measurements shall agree to within $\pm$ .02 cm.

3. The student shall make 5 measurements using a micrometer caliper. The measurements will agree to within $\pm$ .002 cm.

4. The student shall make 5 mass determinations using a single beam torsion balance, the values are to agree to within $\pm$ .1 gm.

5. The student shall make 5 mass determinations using a double pan balance, the values are to agree to within $\pm$ .2 gm.

6. The student shall answer correctly 8 out of 10 questions regarding bearing.

3rd and 4th Weeks

1. The student shall be able to give examples of 5 vector quantities and 5 scalar quantities.

2. The student shall solve correctly 8 out of 10 problems involving resolution and composition of vectors.

3. The student shall be able to construct a table of the British Engineering System, the MKS and the CGS Systems.

4. The student shall be able to work 8 out of 10 problems involving the acceleration due to gravity.

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5th and 6th Weeks

1. The student shall determine the mass densities of various geometrical solids using a spring balance.

2. The students shall investigate composition of forces, equilibrium of forces and resolution of vectors using a vector force table.

3. The student shall determine the equilibrant of two parallel forces using the force table.

4. The student shall determine the conditions for equilibrium of several parallel forces with a demonstration balance support and therefore "discover" torques.

5. The student shall work 8 out of 10 problems involving torques.

6. The student shall determine the coefficient of friction between a sliding block of wood and an inclined plane.

7. The student shall determine the variables which affect the period of a pendulum.

7th Week

1. The student shall study the three classes of levers.

2. The student shall determine the efficiency and mechanical advantage of various types of pulleys.

3. The student shall determine the mechanical advantage of a wheel and axle.

8th and 9th Weeks

1. The student shall work correctly 8 out of 10 force problems.

2. The student shall work correctly 8 out of 10 torque problems.

3. The student shall work correctly 18 out of 20 motion problems (velocity, acceleration, momentum, universal gravitation and circular motion).

4. The student shall work 8 out of 10 problems relating work, power and energy.

5. The student shall be able to solve 4 out of 5 problems involving relativistic mass variations.

10th and 11th Weeks - Electrostatics

1. The student shall be able to explain the theory supporting the electrical nature of matter.

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2. The student shall develop an understanding of Coulomb's Law and demonstrate skills in applying the Law by answering 8 out of 10 questions relating to it.

12th and 13th Weeks

1. The student shall demonstrate how bodies can be charged by conduction and induction by using pith balls, wool and silk with glass rods and rubber rods.

2. The student shall demonstrate an understanding of charge density, equipotential lines, electric field intensity, electric dipole moment, potential difference, capacitance and the nature of metals by answering 18 out of 20 questions and working 8 out of 10 problems.

3. The student shall develop skills in the solution of problems involving capacitors in series and in parallel, electric fields and potential difference and demonstrate this skill by working 8 out of 10 problems.

14th and 15th Weeks - Direct Current Circuits

1. The student shall correctly answer 8 out of 10 questions involving various sources of direct current.

2. The student shall develop an understanding of the principles of operation of various types of electrochemical cells primary, storage and fuel cells by answering 8 out of 10 questions.

3. The student shall demonstrate skill in the use of Ohm's Law as it applies to various direct current circuits by solving 9 out of 10 problems involving its application.

4. The student shall develop an understanding of the laws of resistance measurements for conductors, semi-conductors and super-conductors.

16th Week

1. The student shall demonstrate a knowledge of the instrumentation necessary for the measurement of resistance.

2. The student shall demonstrate knowledge of the total field of direct current such as: ampere, anode, cathode, current flow, emf, ohm, series connection, parallel connection and resistance by answering 18 out of 20 questions dealing with the above.

17th and 18th Weeks - Heating and Chemical Effects

1. The student shall demonstrate an understanding of the conversion of electrical energy expended in a resistance to heat energy.

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2. The student shall demonstrate skill in the application of Joule's Law by solving 4 out of 5 problems.

3. The student shall demonstrate knowledge of the conditions necessary for maximum transfer of electrical power by stating the conditions.

4. The student shall demonstrate skill in the use of Faraday's Laws of Electrolysis.

19th Week

1. The student shall demonstrate an understanding of all previously assigned work during weeks 17 and 18.

20th and 21st Weeks

1. The student shall demonstrate an understanding of the domain of E & M Theory plays in physics.

2. The student shall demonstrate an understanding of unit poles, flux lines, magnetic field intensity, magnetic induction and permeability.

3. The student shall be able to discuss the importance of Oersted's discovery.

4. The student shall demonstrate an ability to apply Ampere's rules by applying them in lab work.

5. The student shall define the following terms:

   a. diamagnetism
   b. electron spin
   c. ferromagnetism
   d. hysteresis
   e. paramagnetism

22nd and 23rd Weeks - Electromagnetic Induction

1. The student shall discuss the basic concepts of electricity generation.

2. The student shall demonstrate an understanding of Lenz's Law.

3. The student shall demonstrate an understanding of "a-c" instrumentation.

4. The student shall demonstrate an understanding of mutual inductance and self-inductance.

24th and 25th Weeks - A-C Circuits

1. The student shall demonstrate an understanding of the terms effective and maximum values of a-c current and voltage.

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2. The student shall understand the principles of a-c meters.

3. The student shall understand the relationships between current-voltage phases in RLC circuits.

4. The student shall demonstrate an understanding of the following terms:

   a. reactance
   b. impedence
   c. actual power
   d. power factor

26th and 27th Weeks - Resonance

1. The student shall demonstrate an understanding of the conditions for resonance.

2. The student shall demonstrate an understanding of selectivity in series and parallel circuits.

3. The student shall be able to explain how a transformer acts as a coupling device.

4. The student shall demonstrate an understanding of low-pass, high-pass and band-pass filters.

5. The student shall demonstrate an understanding of basic microwave theory